

REMARKS

The Examiner has objected to Fig. 20 of the drawings, informalities in the specification and in claims 4 and 23, and rejected claims 1-19, 21-24, and 26-27 under 35 U.S.C. § 103. The Examiner has objected to claims 20 and 25, but indicated that these claims would be allowable if rewritten in independent form, which Applicants acknowledge with gratitude.

By this Amendment, Applicants correct Fig. 20, correct informalities in the specification and claims 4 and 23, traverse the rejections of claims 1-19, 21-24, and 26-27, submit new claims 28-30, cancel claim 24, and rewrite claims 20 and 25 in independent form.

In paragraph 1 of the Office Action, Fig. 20 is objected to because the x and y axes have not been labeled. Applicants submit herewith a redline copy and a formal copy of corrected Fig. 20. These changes to Fig. 20 do not add new matter. Support for these changes can be found in the present specification at page 49, lines 19-20. Approval of this drawing change and withdrawal of the objection to the drawings is thus respectfully requested.

In paragraph 2 of the Office Action, informalities in the specification have been objected to. The Examiner has offered very helpful suggestions for correcting the informalities, which Applicants herein adopt. These changes correct typographical, idiomatic and syntactical errors and do not add new matter. Withdrawal of the objection to the specification is thus respectfully requested.

In paragraph 3 of the Office Action, informalities in claims 4 and 23 are objected to. Applicants have corrected these informalities. Withdrawal of the objection to claims 4 and 23 is respectfully requested.

In paragraph 5 of the Office Action, claims 1-19, 21-22 and 26-27 are rejected under 35 U.S.C. § 103 over Sato, U.S. Patent No. 6,313,392, in view of Applicants' admitted prior art in Fig. 2. Applicants respectfully traverse this rejection.

Among the limitations of claim 1, as amended, nowhere shown or suggested by either Sato or Fig. 2 is a thermoelectric material as claimed having "a density equal to or greater than

98% with respect to the density of Bi_2Te_3 , said thermoelectric material having crystal grains with (001) crystal planes substantially parallel to said direction at a certain ratio, said grain size and said density so as to render the figure of merit equal to or greater than $3.0 \times 10^{-3}/\text{K}$.”

Neither Sato nor Fig. 2 of Applicants’ admitted art shows or suggests the cooperation of the foregoing three factors -- crystal orientation, grain size and density -- to achieve the favorable figure of merit, which exceeds any figure of merit in prior art thermoelectric material. (See page 5, line 20 – page 6, line 1.) Sato and Fig. 2 fail to disclose how these three factors, in combination as claimed, render the figure of merit equal to or greater than $3.0 \times 10^{-3}/\text{K}$. Sato discloses obtaining a figure of merit of, at most, $2.52 \times 10^{-3}/\text{K}$. (See column 35, Table 3.) Fig. 2 does not show a figure of merit at all, much less the value of any figure of merit. It is the inventors’ discoveries that teach obtaining such a high figure of merit. Further still, neither Sato nor Fig. 2 shows or suggests the critical ratio that the claimed crystal grains occupy an area equal to or less than 10% on a section perpendicular to the direction of electrical current, as required by claim 1. Nor do Sato or Fig. 2 show how to achieve the desirable figure of merit with a density less than that in Sato. This feature of the present invention affords manufacturers wider options. Thus, even if one were to combine Sato and Fig. 2, one would not arrive at the present invention as defined in claim 1.

For the foregoing reasons, claim 1 of the present invention is patentable over Sato in view of Fig. 2. Withdrawal of the rejection of claim 1 on this ground is respectfully requested. Claims 2-3 depend on claim 1. Also, new claim 29 depends on claim 1. Each of these dependent claims includes added limitations that, in combination with the limitations of claim 1, are neither shown nor suggested in the prior art of record. Withdrawal of the rejections of claims 2-3 is respectfully requested.

The Office Action further rejects independent claim 4 over Sato in view of Fig. 2. Applicants respectfully traverse this rejection.

Among the limitations of claim 4 nowhere shown or suggested by either Sato or Fig. 2 is a process for producing a thermoelectric material as claimed that shows “rapidly solidifying

said fusion so as to obtain flakes of said thermoelectric material [and] stacking said flakes so as to form a lamination [and further] pressurizing said lamination for extruding a bulk of said thermoelectric material from said die unit. . . .” Neither Sato nor Fig. 2 show or suggest stacking flakes of thermoelectric material to form a lamination, and then extruding such lamination from the die unit, as required by claim 4. Sato shows using “laminated thin powder 18” (column 23, line 44) as the basis of the thermoelectric material. Sato does not show using flakes, as required by claim 4. Thus, even if one were to combine Sato and Fig. 2, one would not arrive at the present invention as defined in claim 4. Indeed, the lamination of flakes in the present invention is advantageous in orienting the crystal grains in a target direction, as opposed to the use of powder.

For the foregoing reasons, claim 4 is patentable under 35 U.S.C. § 103 over Sato in view of Fig. 2. Withdrawal of the rejection of claim 4 is respectfully requested.

Claims 5-19 and 22 depend on independent claim 4. Each of these dependent claims includes additional limitations that, in combination with the limitations of claim 4, are neither shown nor suggested in the art of record. The explanation with respect to independent claim 4 is equally applicable to dependent claims 5-19 and 22. Applicant thus respectfully submits that claims 5-19 and 22 are patentable over Sato in view of Fig. 2. Withdrawal of the rejections of claims 5-19 and 22 is thus respectfully requested.

In paragraph 6, the Office Action rejects claim 21 under 35 U.S.C. § 103 over Sato in view of Fig. 2, and in further view of Fukuda, U.S. Patent No. 6,274,802. Claim 21 depends from claim 4. Nothing in Fukuda, however, cures the deficiencies of Sato combined with Fig. 2 as described above with respect to the flake limitation. For this reason, claim 21 is patentable under 35 U.S.C. § 103 over Sato in view of Fig. 2, and in further view of Fukuda. Withdrawal of the rejection of claim 21 is thus respectfully requested.

In paragraph 7 of the Office Action, claims 23-24 are rejected under 35 U.S.C. § 103 over Fukuda in view of Fig. 2. Applicant has cancelled claim 24, rendering the rejection thereon moot. Applicant respectfully traverses the rejection of claim 23.

Among the limitations of claim 23 nowhere shown or suggested by Fukuda or Fig. 2 is “pressurizing said ingot [of thermoelectric material] for extruding a bulk of said thermoelectric material from said die unit at least once so that a shearing force is exerted on said ingot at a boundary between said inlet portion and said outlet portion.” Nowhere do Fukuda or Fig. 2 show extruding an ingot of thermoelectric material. Fukuda discloses a process comprising the steps of pulverizing an ingot into powder, sintering the powder and solidifying the powder through forging. Fig. 2 shows forming a green compact from powder. (Page 3, lines 21-22.) Thus, even if one were to combine Fukuda and Fig. 2, one would not arrive at the present invention as defined in claim 23.

For the foregoing reasons, claim 23 is patentable under 35 U.S.C. § 103 over Fukuda in view of Fig. 2. Withdrawal of the rejection of claim 23 is respectfully requested.

The Office Action rejects claim 26 over Sato in view of Fig. 2, incorporating the grounds for rejection asserted against claims 1 and 4. Claim 26, as amended, is patentably distinct over the cited art for the same reasons as claim 1, as explained above. Withdrawal of the rejection of claim 26 is respectfully requested. New claim 30 depends from claim 26, and contains all the limitations therein.

Further, Applicants add new claim 28. Applicants submit that claim 28 is patentable over the art of record for reasons set forth above.

The Office Action provides that claims 20 and 25 would be allowable if rewritten in independent form including all the limitations of the base claims, which Applicants acknowledge with gratitude. Applicants have rewritten the claims in accord with the Examiner's requirements.

Finally, the Office Action indicates that an Information Disclosure Statement is attached. The Office Action received by Applicants, however, did not contain the referenced IDS. Applicants submit herewith another copy of the PTO 1449 previously submitted on November 29, 2001. Applicants respectfully request that the Examiner initial and forward to Applicants this copy of the PTO 1449.

Applicants have corrected Fig. 20 of the drawings, corrected informalities in the specification and claims 4 and 23, submitted new claims 28-30, rewritten claims 20 and 25 in independent form, and cancelled claim 24. Additionally, Applicants have shown that claims 1-19, 22 and 26-27 are patentable under 35 U.S.C. § 103 over Sato in view of Fig. 2. Applicants have further shown that claim 21 is patentable under 35 U.S.C. § 103 over Sato in view of Fig. 2, and in further view of Fukuda. Applicants have further shown that claims 23-24 are patentable under 35 U.S.C. § 103 over Fukuda in view of Fig. 2. Applicants have added new claims 28-30 which Applicants submit are patentable for reasons based on those explained above. As each of the pending claims is currently in condition for allowance, such action is earnestly solicited.

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Respectfully submitted,

By 

Michael J. Scheer

Registration No.: 34,425

DICKSTEIN SHAPIRO MORIN &
OSHINSKY LLP

1177 Avenue of the Americas

41st Floor

New York, New York 10036-2714

(212) 835-1400

Attorney for Applicants